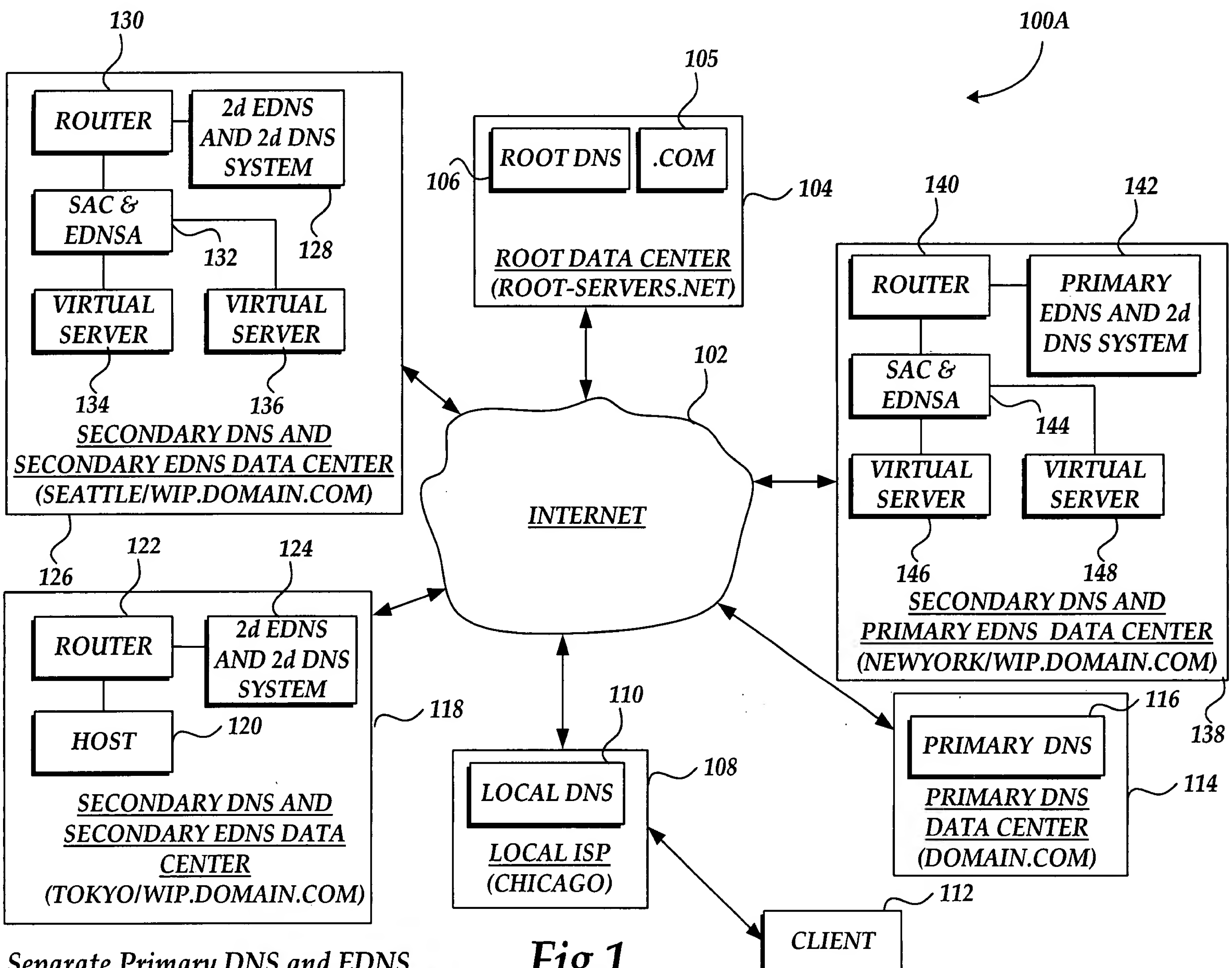


Separate Primary DNS and EDNS

Fig.1

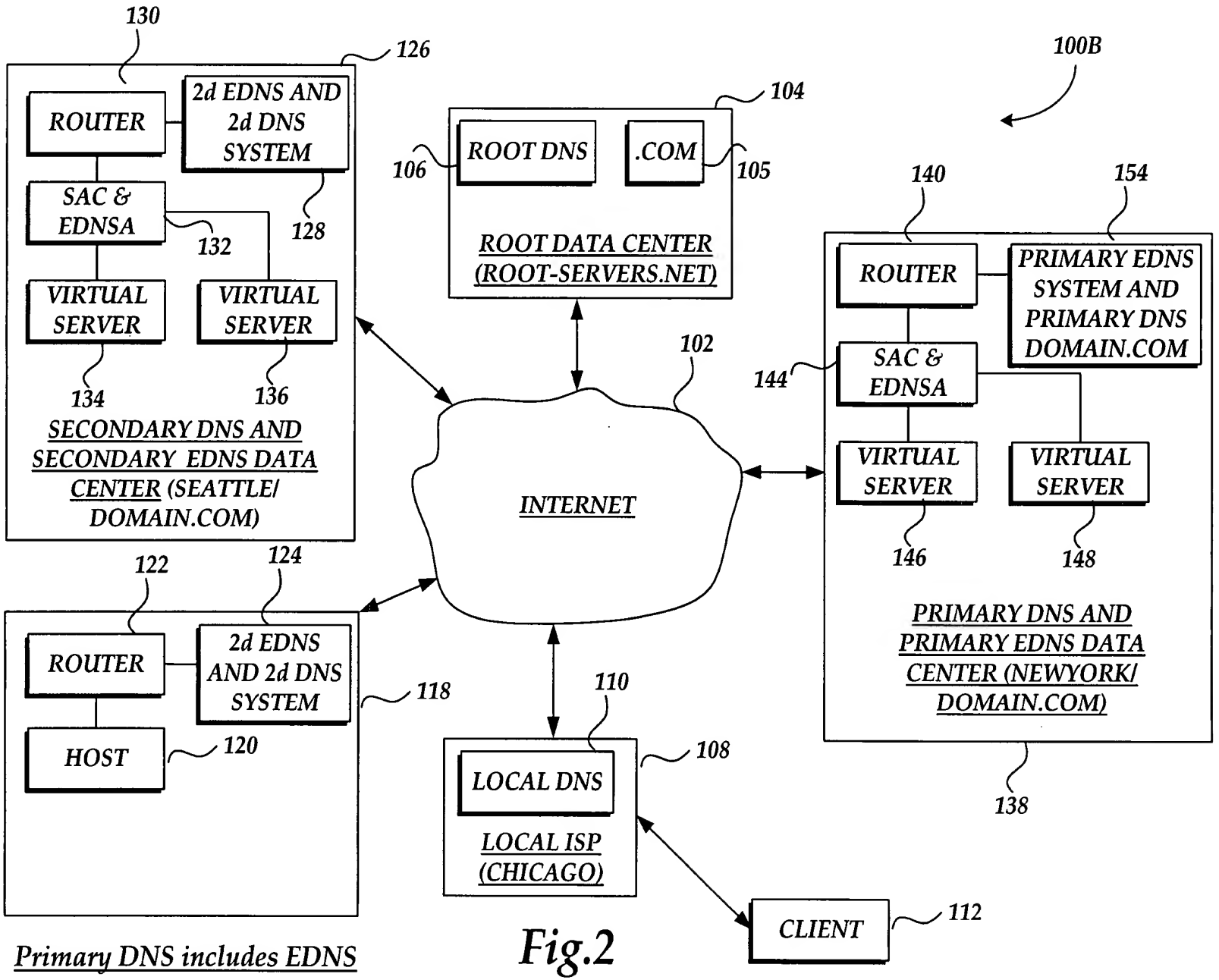
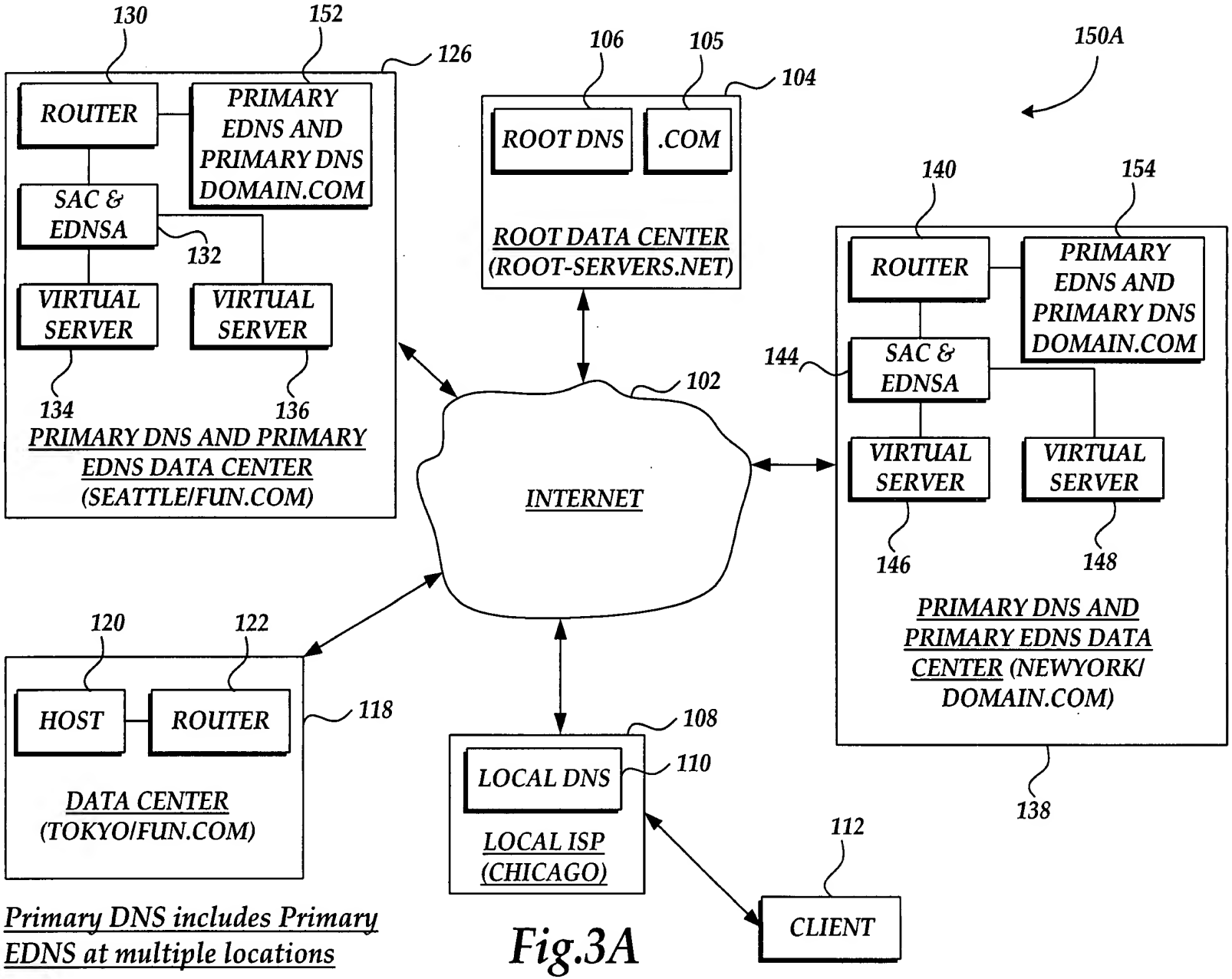

130
126
100B
ROUTER
2d EDNS AND 2d DNS SYSTEM
104
ROOT DNS
.COM
106
105
SAC & EDNSA
132
128
140
154
ROUTER
PRIMARY EDNS SYSTEM AND PRIMARY DNS DOMAIN.COM
VIRTUAL SERVER
VIRTUAL SERVER
ROOT DATA CENTER (ROOT-SERVERS.NET)
102
144
SAC & EDNSA
134
136
SECONDARY DNS AND SECONDARY EDNS DATA CENTER (SEATTLE/ DOMAIN.COM)
INTERNET
VIRTUAL SERVER
VIRTUAL SERVER
146
148
122
124
ROUTER
2d EDNS AND 2d DNS SYSTEM
118
110
PRIMARY DNS AND PRIMARY EDNS DATA CENTER (NEWYORK/ DOMAIN.COM)
HOST
120
108
LOCAL DNS
LOCAL ISP (CHICAGO)
138
CLIENT
112
Primary DNS includes EDNS

Fig.2



Primary DNS includes Primary EDNS at multiple locations

Fig.3A

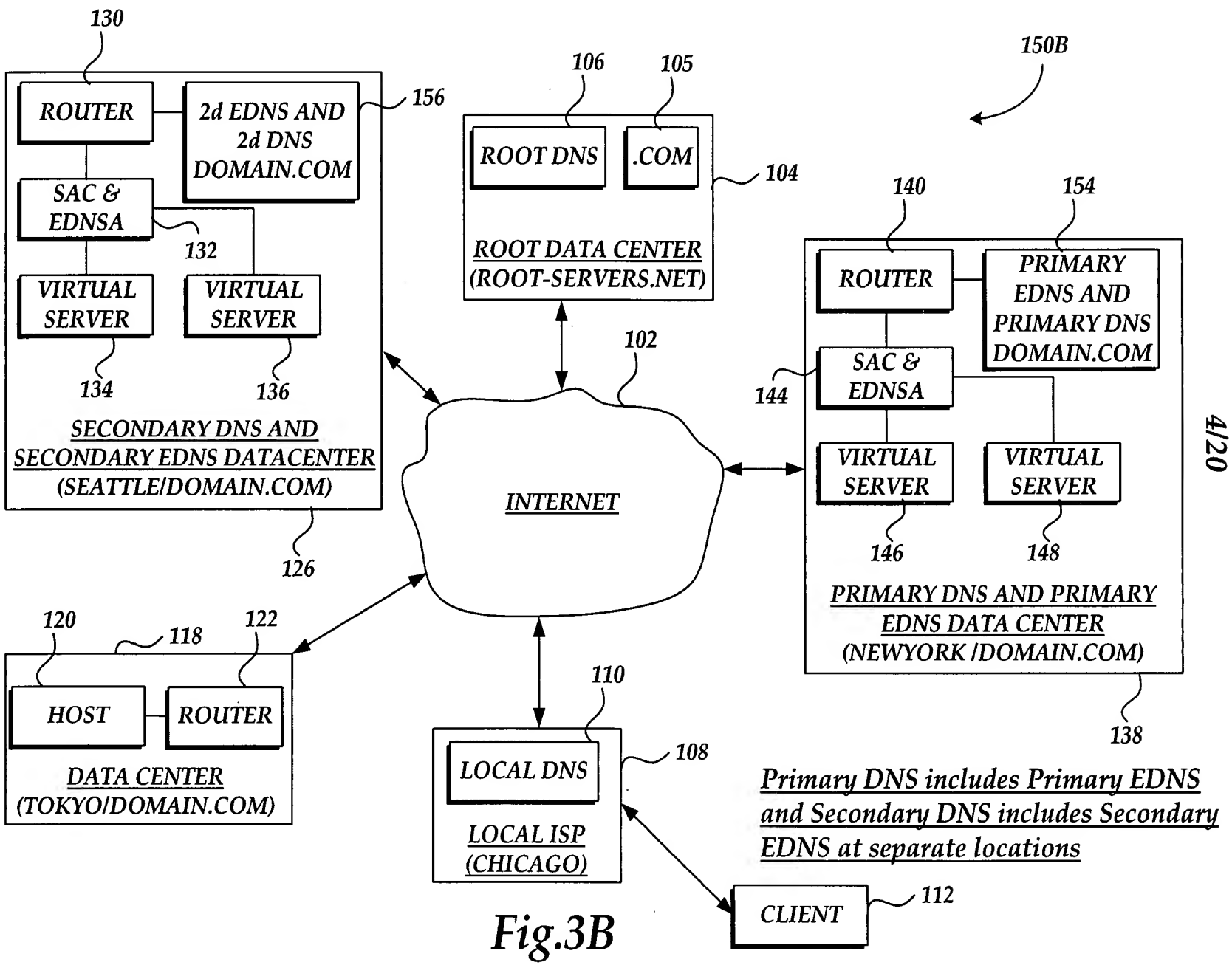

130
ROUTER
2d EDNS AND 2d DNS DOMAIN.COM
156
SAC & EDNSA
132
VIRTUAL SERVER
VIRTUAL SERVER
134
136
SECONDARY DNS AND SECONDARY EDNS DATACENTER (SEATTLE/DOMAIN.COM)
126
106
105
ROOT DNS
.COM
104
ROOT DATA CENTER (ROOT-SERVERS.NET)
102
INTERNET
150B
140
154
ROUTER
PRIMARY EDNS AND PRIMARY DNS DOMAIN.COM
144
SAC & EDNSA
VIRTUAL SERVER
VIRTUAL SERVER
146
148
PRIMARY DNS AND PRIMARY EDNS DATA CENTER (NEWYORK /DOMAIN.COM)
138
120
118
122
HOST
ROUTER
DATA CENTER (TOKYO/DOMAIN.COM)
110
LOCAL DNS
108
LOCAL ISP (CHICAGO)
CLIENT
112
Primary DNS includes Primary EDNS and Secondary DNS includes Secondary EDNS at separate locations

Fig.3B

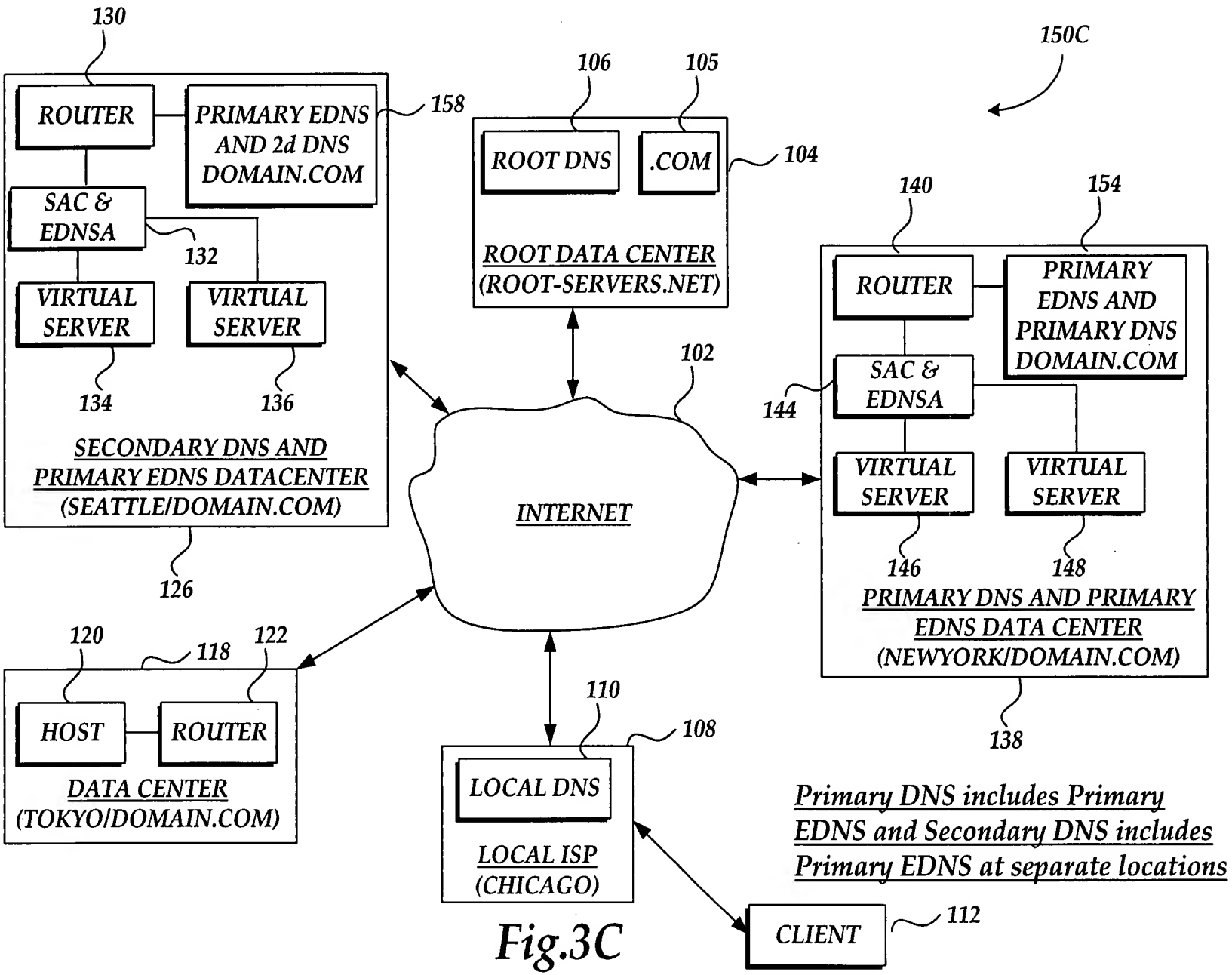

130
ROUTER
PRIMARY EDNS AND 2d DNS DOMAIN.COM
158
SAC & EDNSA
132
VIRTUAL SERVER
VIRTUAL SERVER
134
136
SECONDARY DNS AND PRIMARY EDNS DATACENTER (SEATTLE/DOMAIN.COM)
126
106
105
ROOT DNS
.COM
104
ROOT DATA CENTER (ROOT-SERVERS.NET)
150C
140
154
ROUTER
PRIMARY EDNS AND PRIMARY DNS DOMAIN.COM
144
SAC & EDNSA
VIRTUAL SERVER
VIRTUAL SERVER
146
148
PRIMARY DNS AND PRIMARY EDNS DATA CENTER (NEWYORK/DOMAIN.COM)
138
102
INTERNET
120
118
122
HOST
ROUTER
DATA CENTER (TOKYO/DOMAIN.COM)
110
108
LOCAL DNS
LOCAL ISP (CHICAGO)
CLIENT
112
Primary DNS includes Primary EDNS and Secondary DNS includes Primary EDNS at separate locations

Fig.3C

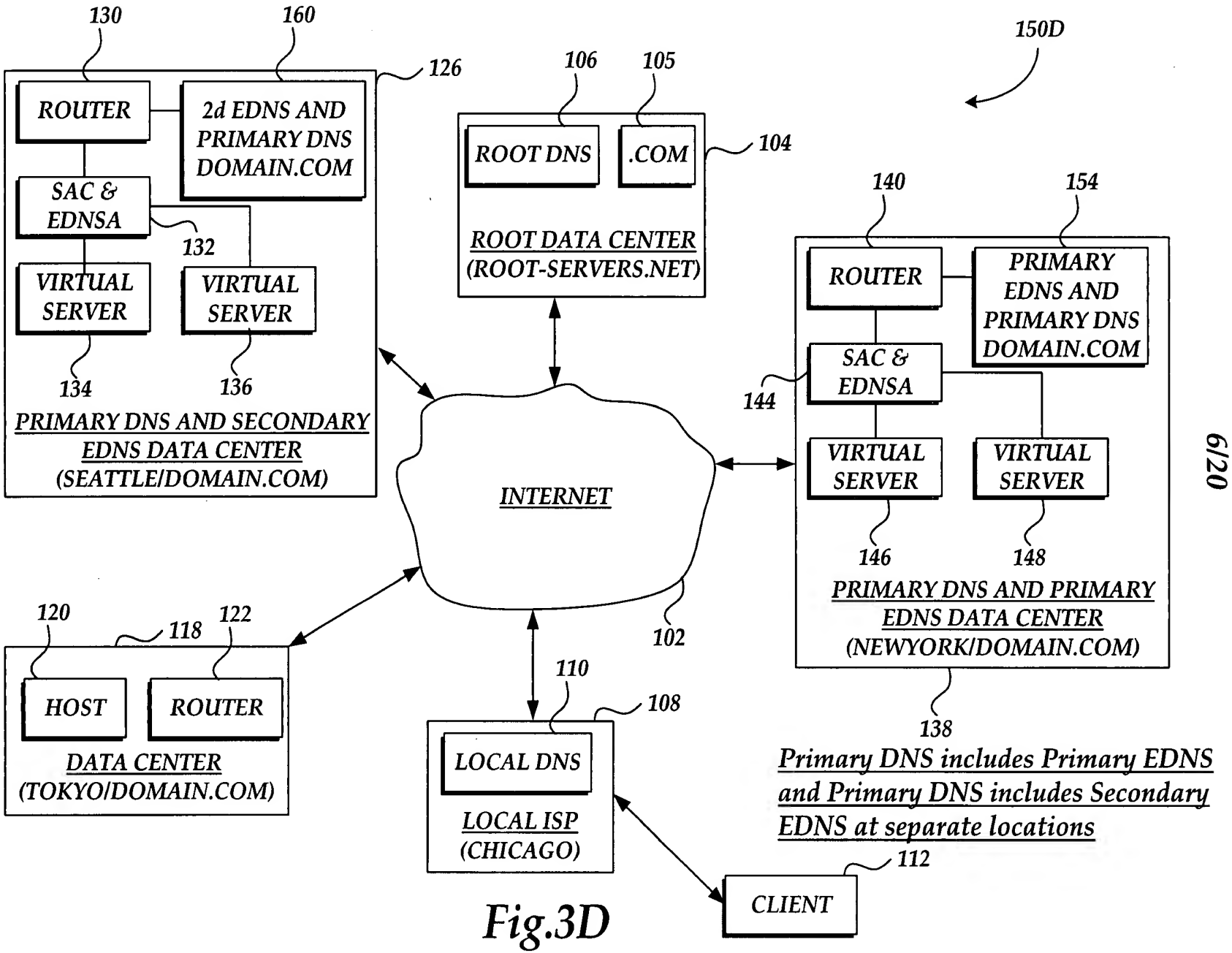

130
160
126
150D
106
105
ROUTER
2d EDNS AND PRIMARY DNS DOMAIN.COM
ROOT DNS
.COM
104
SAC & EDNSA
132
ROOT DATA CENTER (ROOT-SERVERS.NET)
140
154
VIRTUAL SERVER
VIRTUAL SERVER
ROUTER
PRIMARY EDNS AND PRIMARY DNS DOMAIN.COM
134
136
SAC & EDNSA
144
PRIMARY DNS AND SECONDARY EDNS DATA CENTER (SEATTLE/DOMAIN.COM)
INTERNET
VIRTUAL SERVER
VIRTUAL SERVER
146
148
PRIMARY DNS AND PRIMARY EDNS DATA CENTER (NEWYORK/DOMAIN.COM)
120
118
122
102
110
108
HOST
ROUTER
LOCAL DNS
138
Primary DNS includes Primary EDNS and Primary DNS includes Secondary EDNS at separate locations
DATA CENTER (TOKYO/DOMAIN.COM)
LOCAL ISP (CHICAGO)
112
CLIENT

Fig.3D

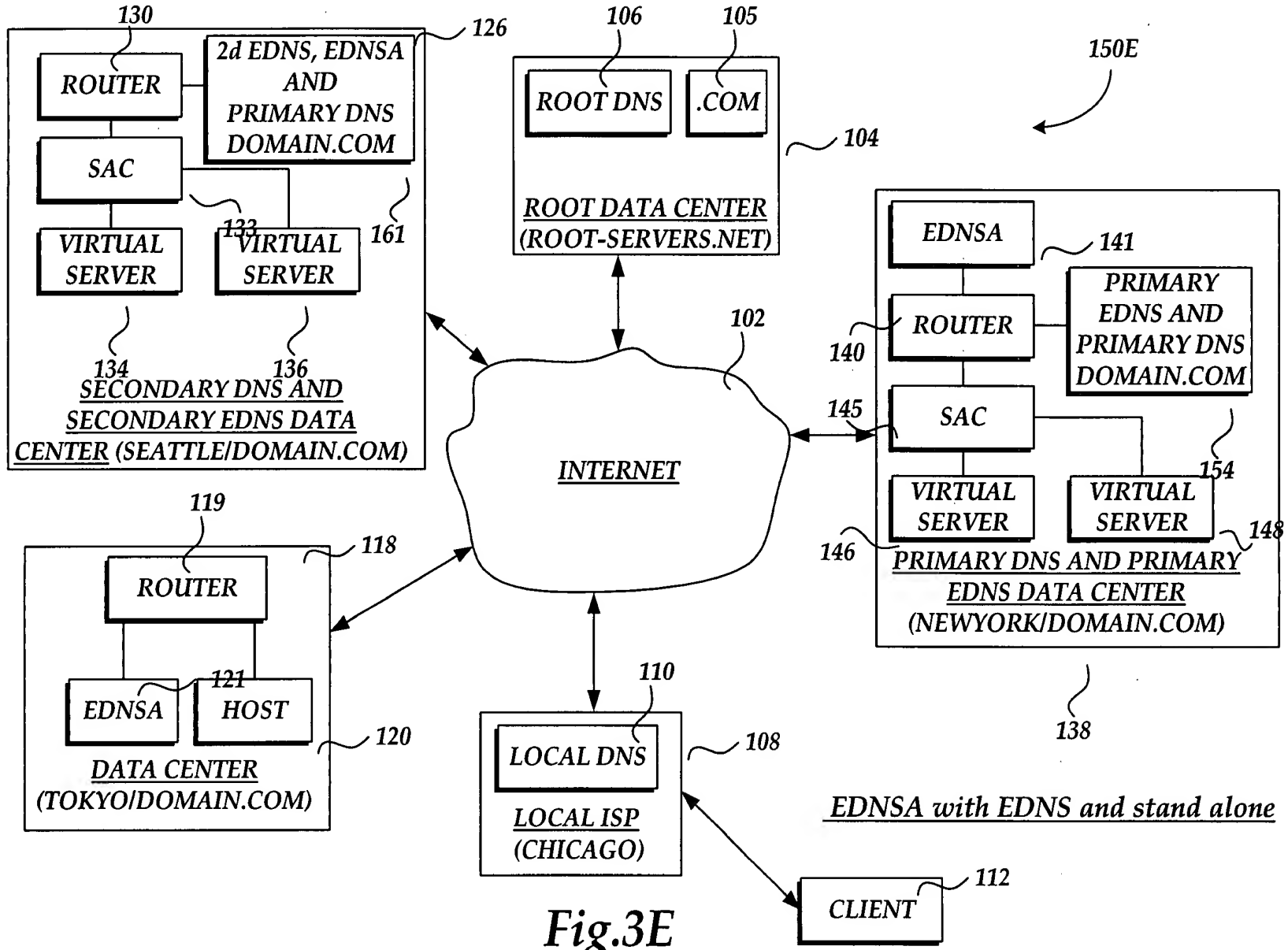

130
ROUTER
2d EDNS, EDNSA AND PRIMARY DNS DOMAIN.COM
126
SAC
VIRTUAL SERVER
132
VIRTUAL SERVER
161
134
136
SECONDARY DNS AND SECONDARY EDNS DATA CENTER (SEATTLE/DOMAIN.COM)
106
105
ROOT DNS
.COM
104
ROOT DATA CENTER (ROOT-SERVERS.NET)
150E
102
INTERNET
EDNSA
141
ROUTER
PRIMARY EDNS AND PRIMARY DNS DOMAIN.COM
140
145
SAC
154
VIRTUAL SERVER
VIRTUAL SERVER
146
148
PRIMARY DNS AND PRIMARY EDNS DATA CENTER (NEWYORK/DOMAIN.COM)
138
119
118
ROUTER
121
EDNSA
HOST
120
DATA CENTER (TOKYO/DOMAIN.COM)
110
LOCAL DNS
108
LOCAL ISP (CHICAGO)
EDNSA with EDNS and stand alone
112
CLIENT

Fig.3E

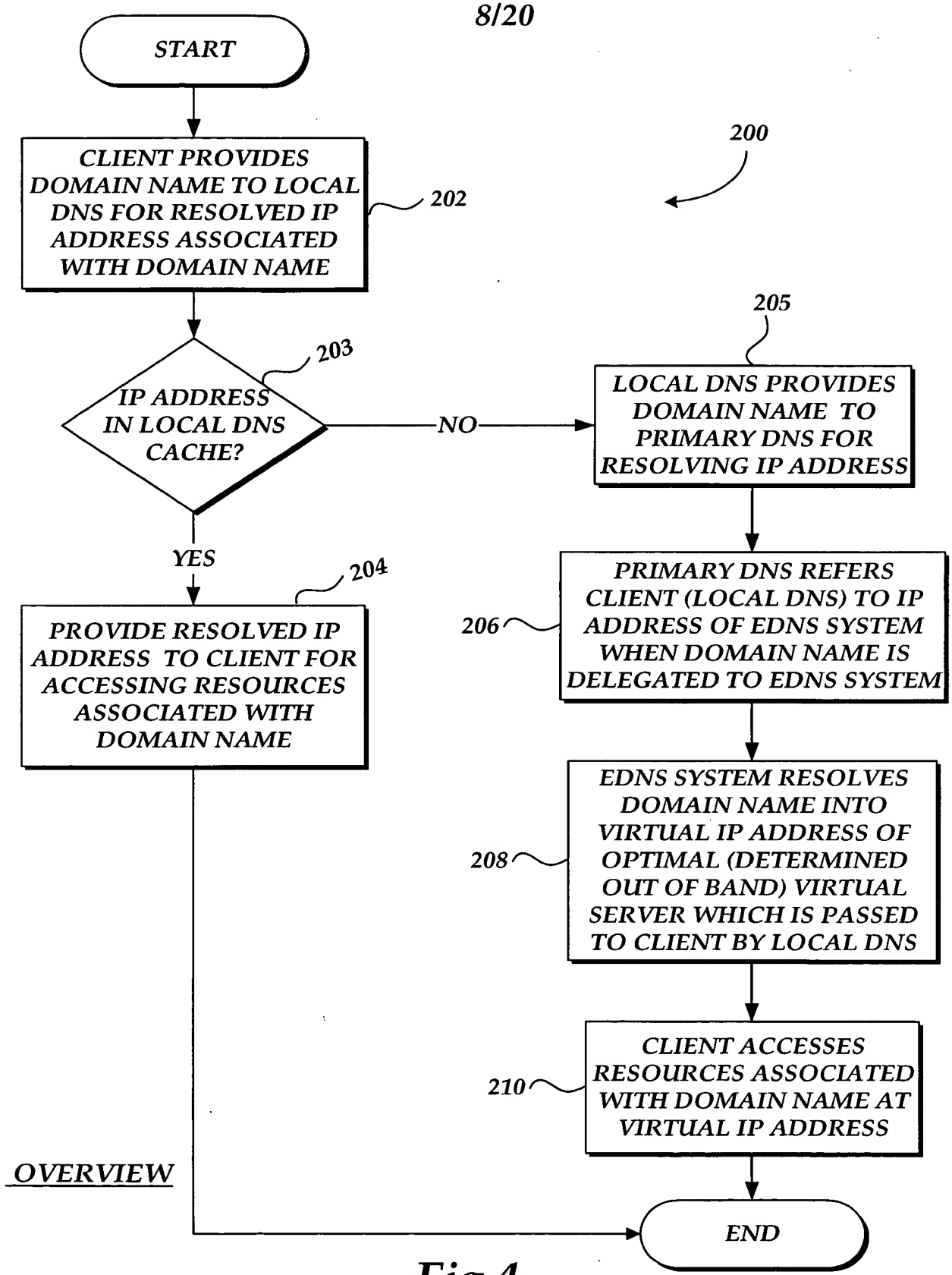
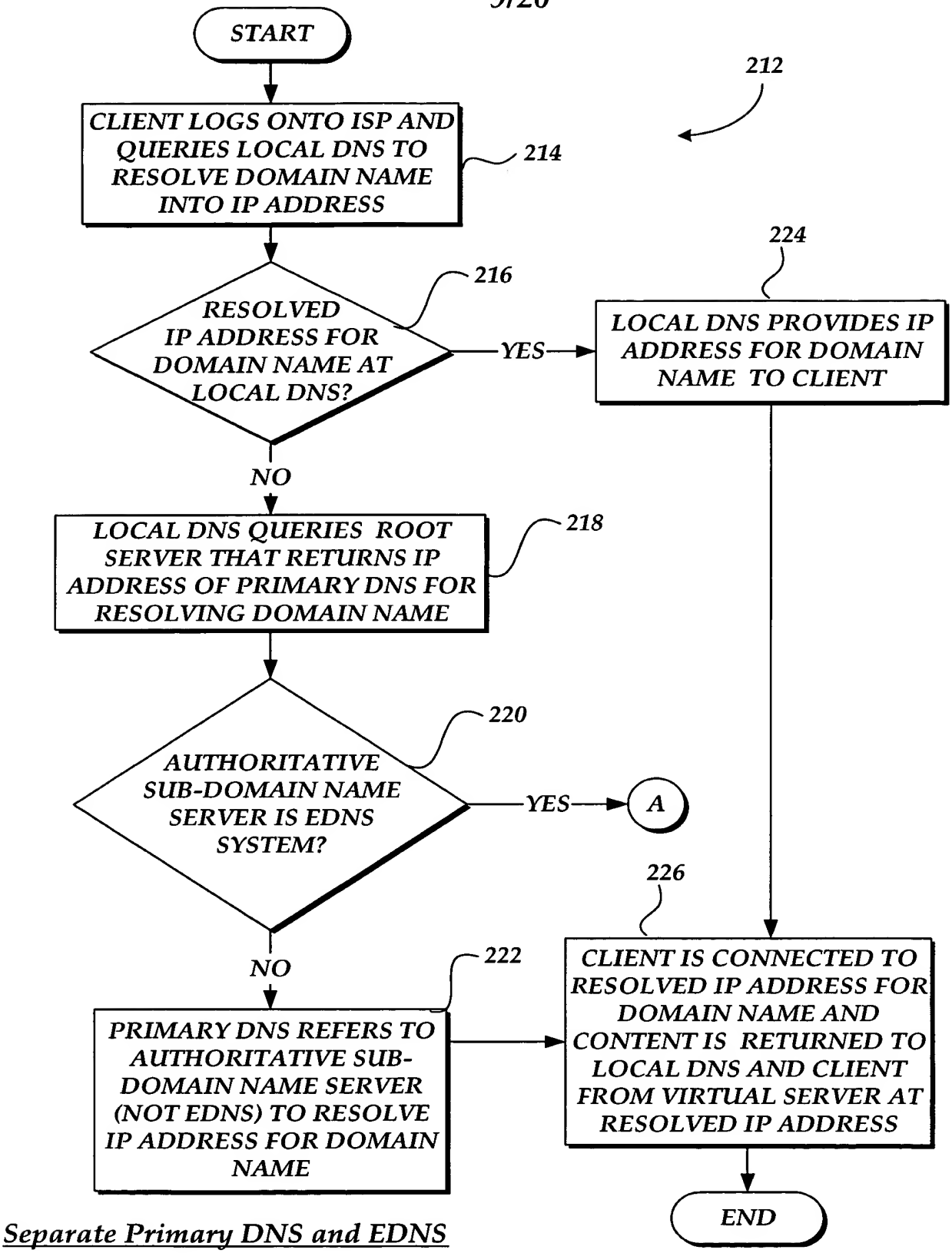
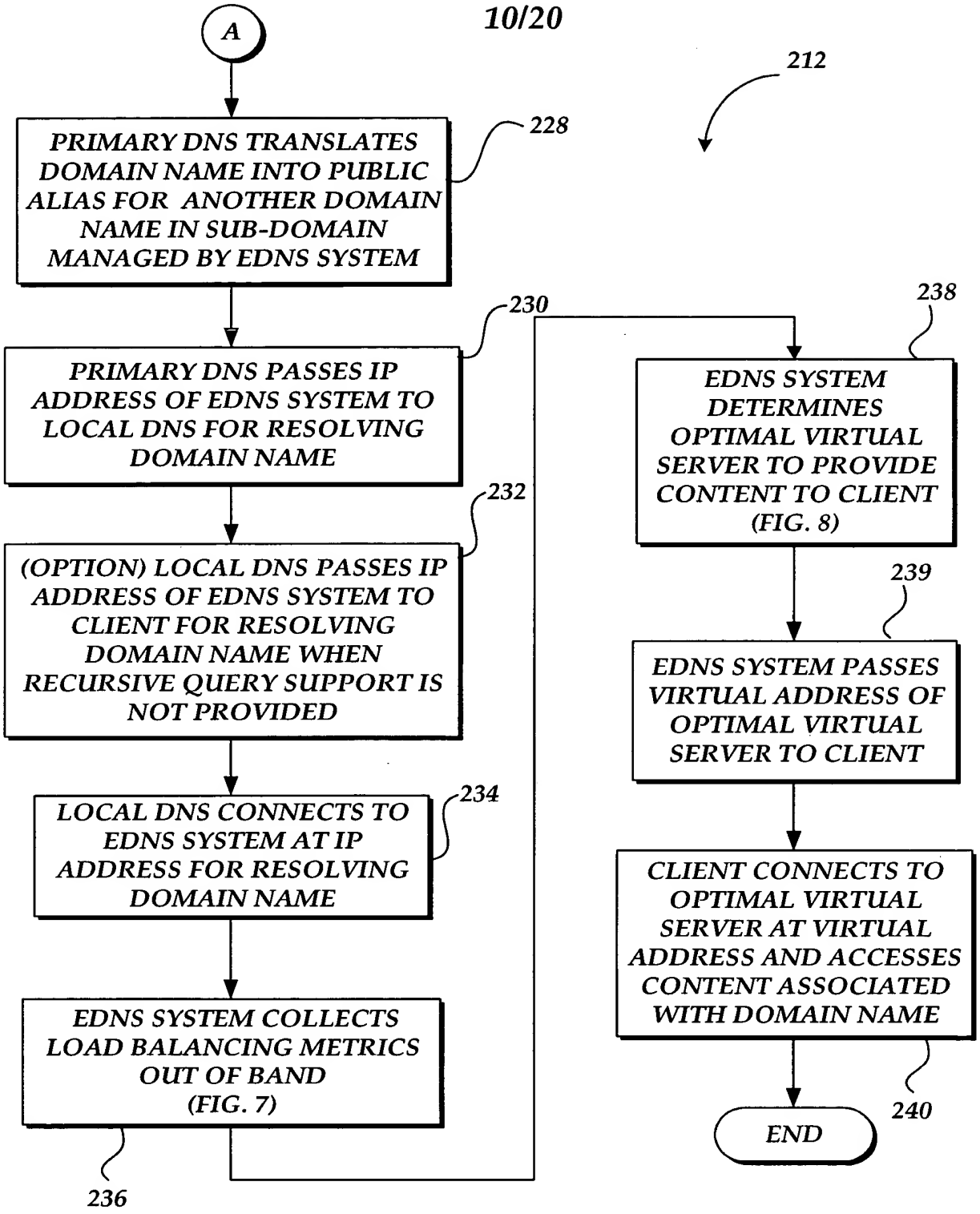

START
CLIENT PROVIDES DOMAIN NAME TO LOCAL DNS FOR RESOLVED IP ADDRESS ASSOCIATED WITH DOMAIN NAME
202
200
205
IP ADDRESS IN LOCAL DNS CACHE?
203
NO
LOCAL DNS PROVIDES DOMAIN NAME TO PRIMARY DNS FOR RESOLVING IP ADDRESS
YES
204
PROVIDE RESOLVED IP ADDRESS TO CLIENT FOR ACCESSING RESOURCES ASSOCIATED WITH DOMAIN NAME
206
PRIMARY DNS REFERS CLIENT (LOCAL DNS) TO IP ADDRESS OF EDNS SYSTEM WHEN DOMAIN NAME IS DELEGATED TO EDNS SYSTEM
208
EDNS SYSTEM RESOLVES DOMAIN NAME INTO VIRTUAL IP ADDRESS OF OPTIMAL (DETERMINED OUT OF BAND) VIRTUAL SERVER WHICH IS PASSED TO CLIENT BY LOCAL DNS
210
CLIENT ACCESSES RESOURCES ASSOCIATED WITH DOMAIN NAME AT VIRTUAL IP ADDRESS
END
OVERVIEW

Fig.4



Separate Primary DNS and EDNS

Fig. 5A



Separate Primary DNS and EDNS

Fig. 5B

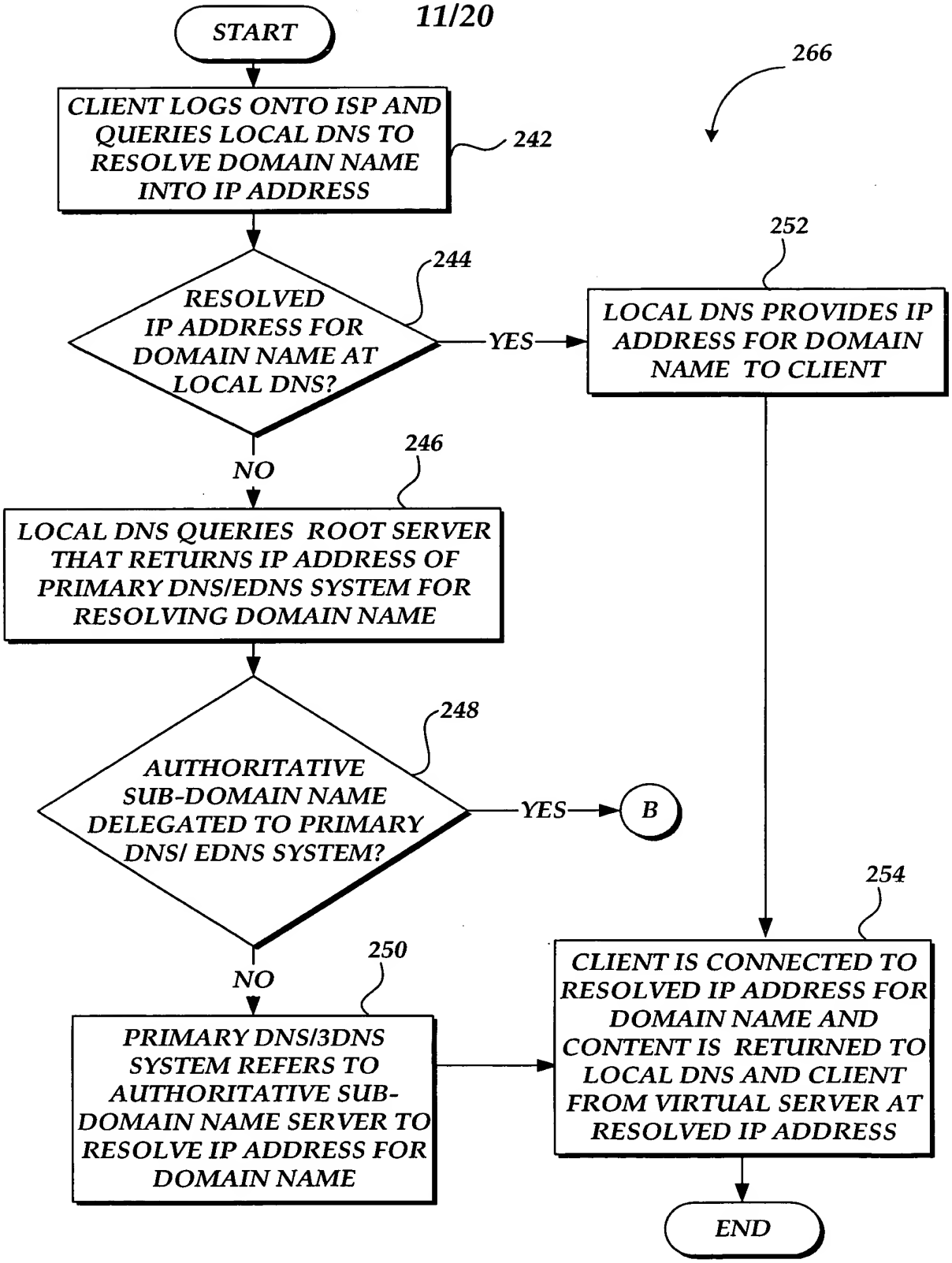
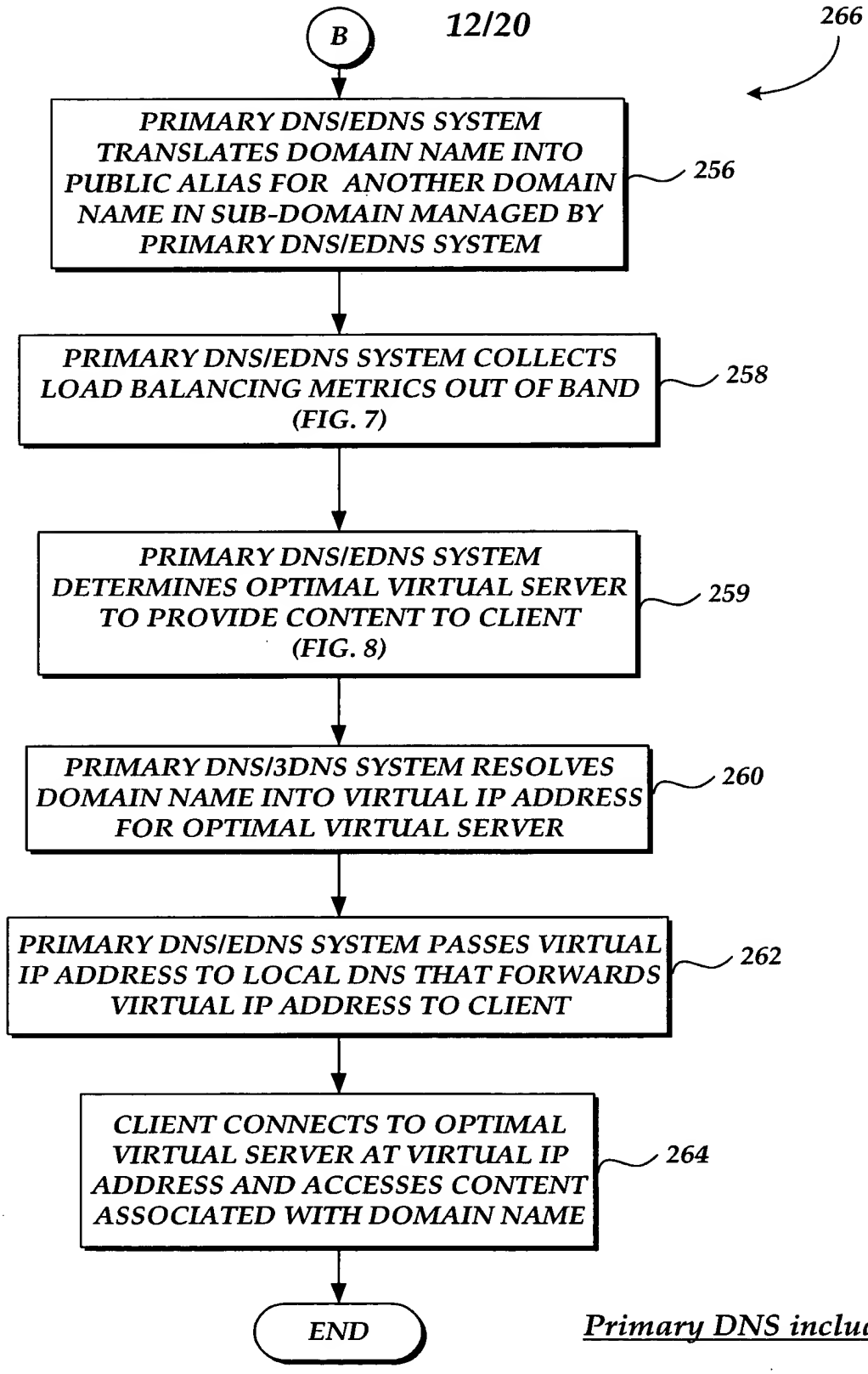


Fig.6A *Primary DNS includes 3DNS*



Primary DNS includes EDNS

Fig. 6B

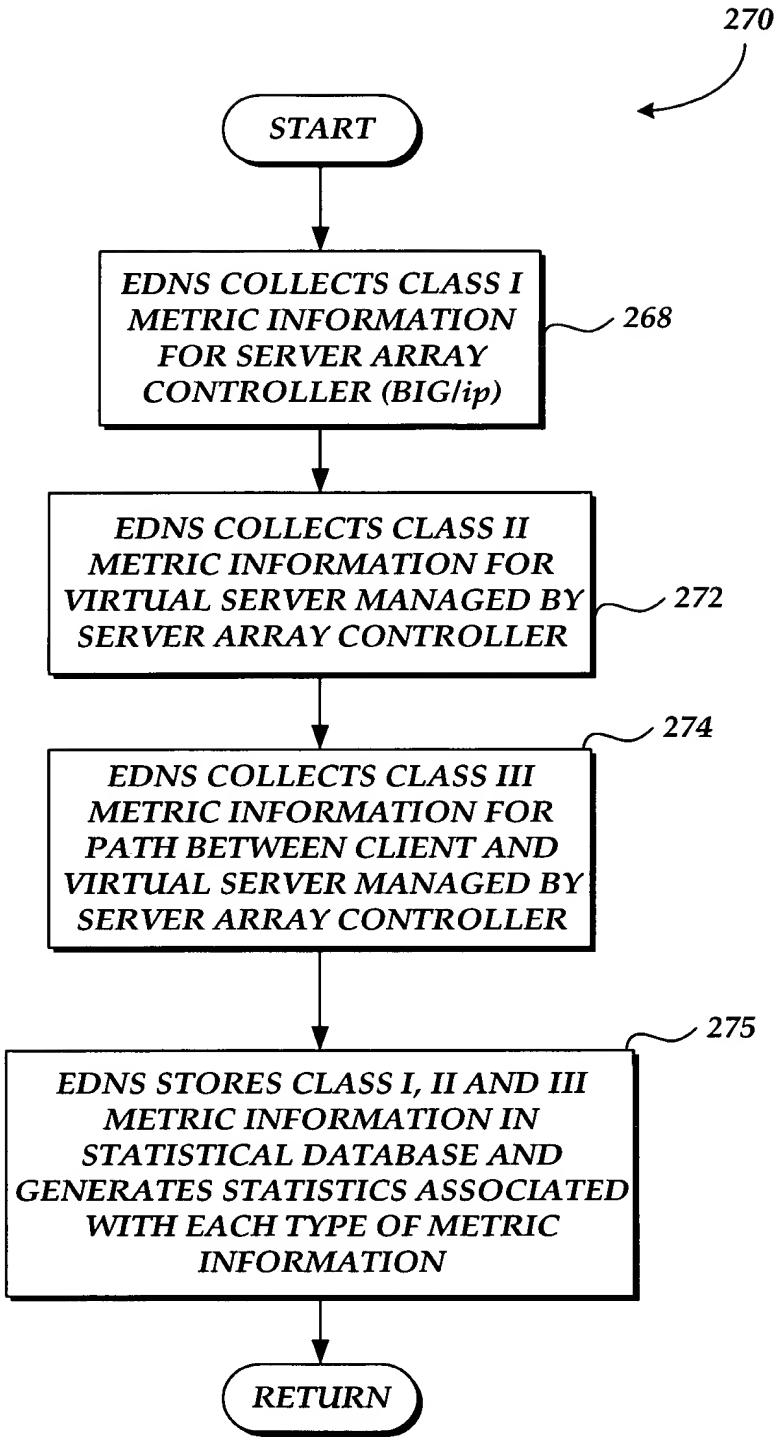

270
START
EDNS COLLECTS CLASS I METRIC INFORMATION FOR SERVER ARRAY CONTROLLER (BIG/ip)
268
EDNS COLLECTS CLASS II METRIC INFORMATION FOR VIRTUAL SERVER MANAGED BY SERVER ARRAY CONTROLLER
272
274
EDNS COLLECTS CLASS III METRIC INFORMATION FOR PATH BETWEEN CLIENT AND VIRTUAL SERVER MANAGED BY SERVER ARRAY CONTROLLER
275
EDNS STORES CLASS I, II AND III METRIC INFORMATION IN STATISTICAL DATABASE AND GENERATES STATISTICS ASSOCIATED WITH EACH TYPE OF METRIC INFORMATION
RETURN

Fig. 7

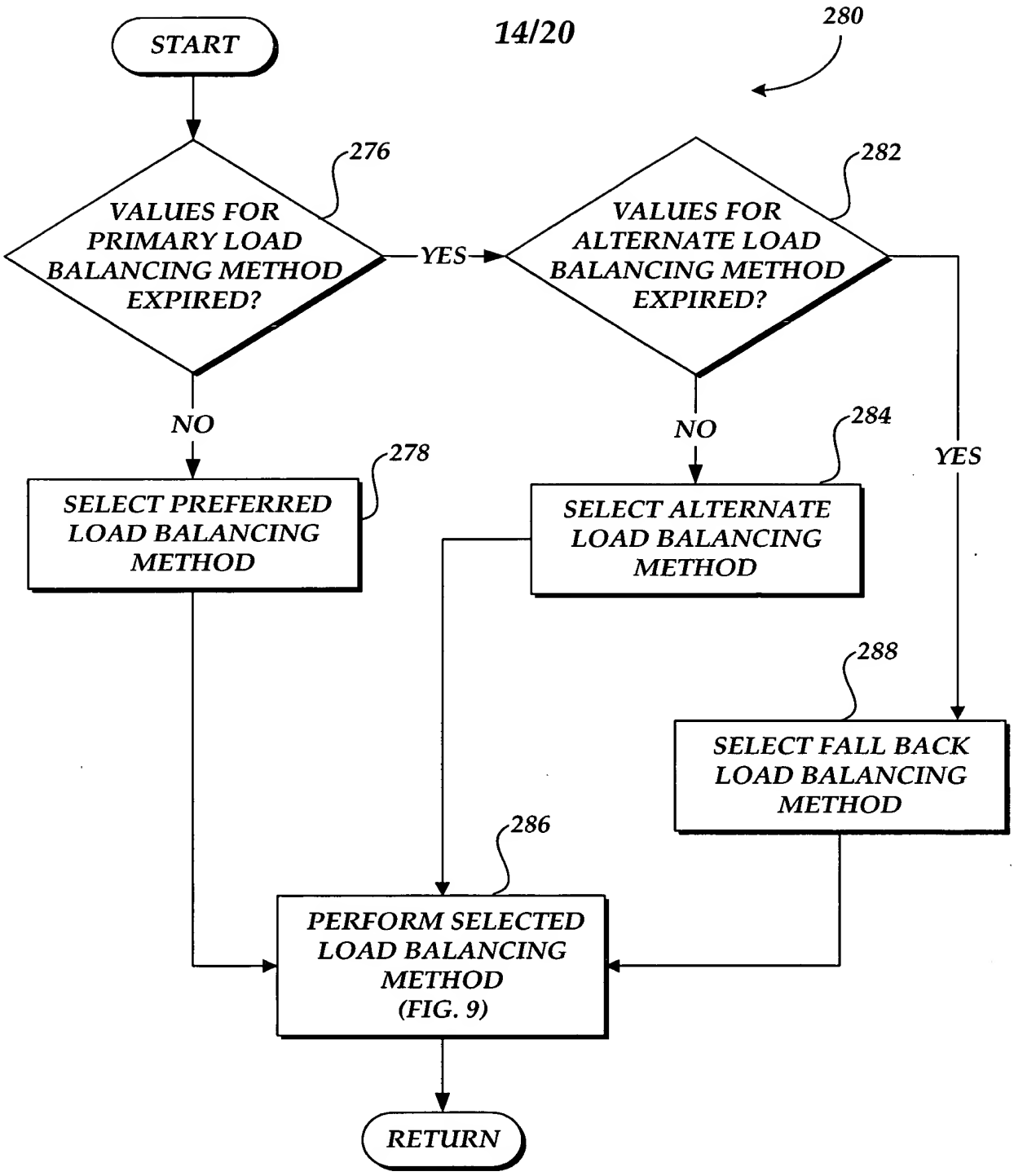

280
START
276
VALUES FOR PRIMARY LOAD BALANCING METHOD EXPIRED?
YES
282
VALUES FOR ALTERNATE LOAD BALANCING METHOD EXPIRED?
NO
278
SELECT PREFERRED LOAD BALANCING METHOD
NO
284
SELECT ALTERNATE LOAD BALANCING METHOD
YES
288
SELECT FALL BACK LOAD BALANCING METHOD
286
PERFORM SELECTED LOAD BALANCING METHOD (FIG. 9)
RETURN

Fig. 8

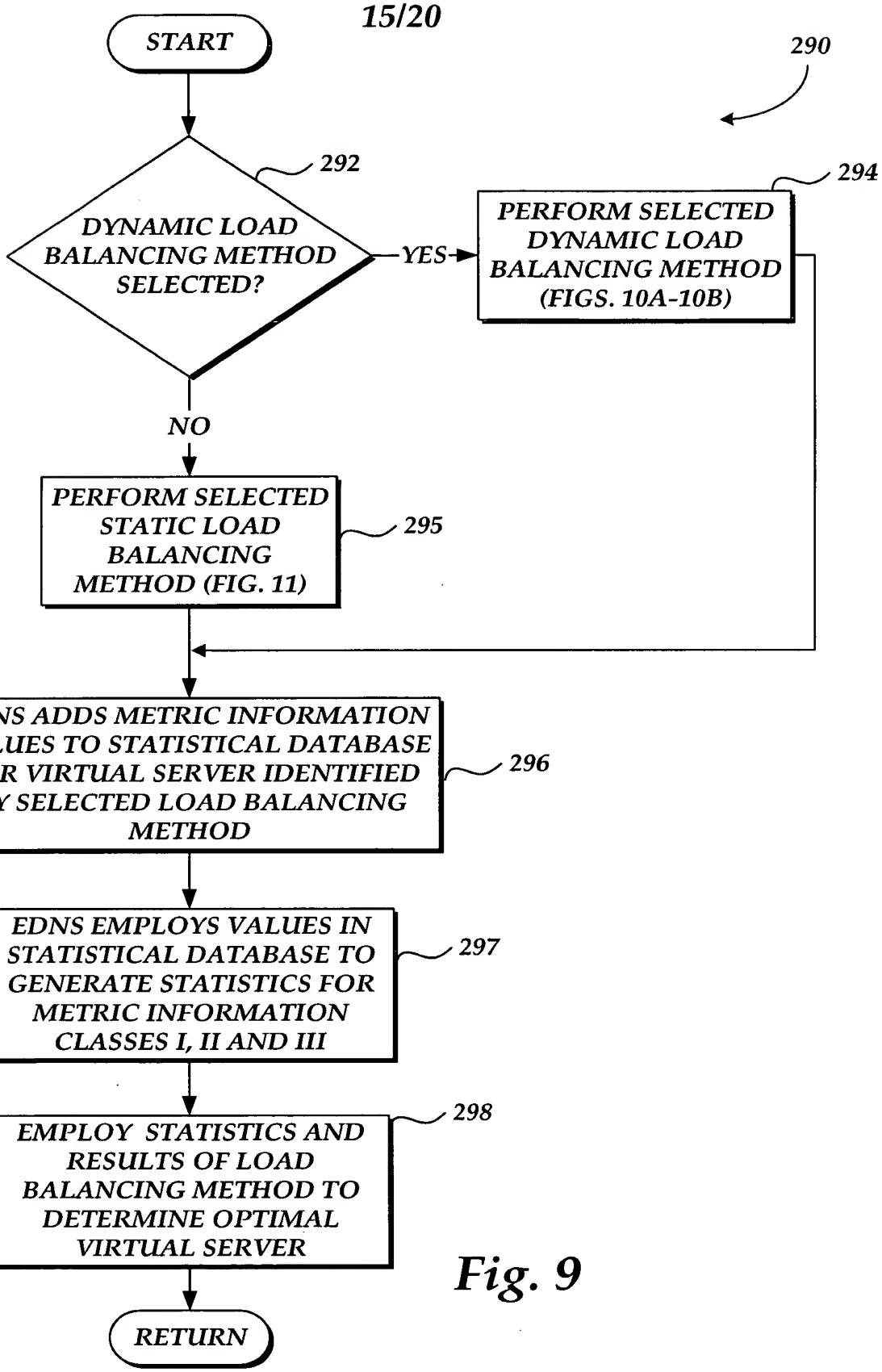

START
290
292
DYNAMIC LOAD BALANCING METHOD SELECTED?
YES
294
PERFORM SELECTED DYNAMIC LOAD BALANCING METHOD (FIGS. 10A-10B)
NO
PERFORM SELECTED STATIC LOAD BALANCING METHOD (FIG. 11)
295
EDNS ADDS METRIC INFORMATION VALUES TO STATISTICAL DATABASE FOR VIRTUAL SERVER IDENTIFIED BY SELECTED LOAD BALANCING METHOD
296
EDNS EMPLOYS VALUES IN STATISTICAL DATABASE TO GENERATE STATISTICS FOR METRIC INFORMATION CLASSES I, II AND III
297
EMPLOY STATISTICS AND RESULTS OF LOAD BALANCING METHOD TO DETERMINE OPTIMAL VIRTUAL SERVER
298
RETURN

Fig. 9

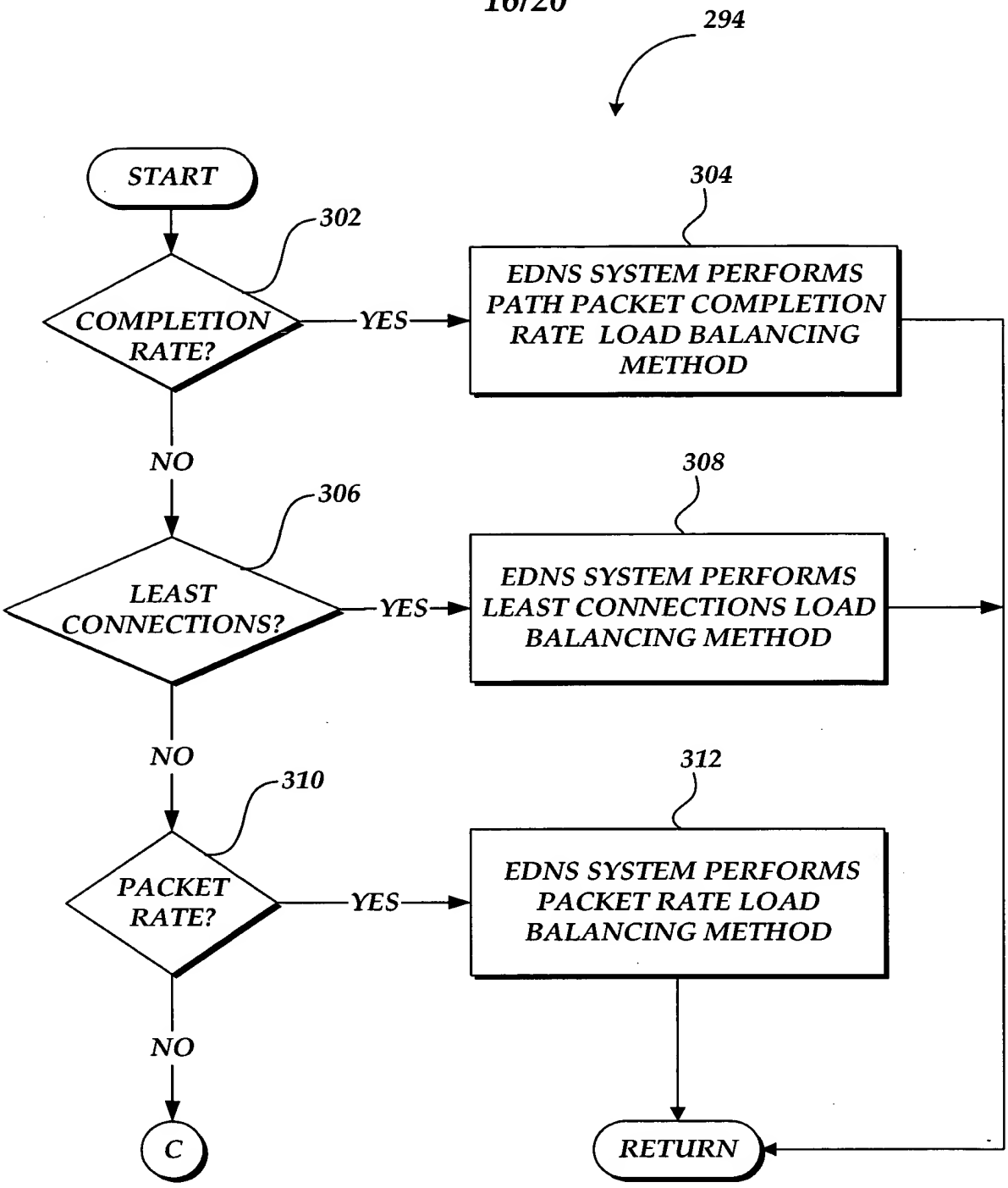

294
START
302
COMPLETION RATE?
YES
304
EDNS SYSTEM PERFORMS PATH PACKET COMPLETION RATE LOAD BALANCING METHOD
NO
306
LEAST CONNECTIONS?
YES
308
EDNS SYSTEM PERFORMS LEAST CONNECTIONS LOAD BALANCING METHOD
NO
310
PACKET RATE?
YES
312
EDNS SYSTEM PERFORMS PACKET RATE LOAD BALANCING METHOD
NO
C
RETURN

Fig. 10A

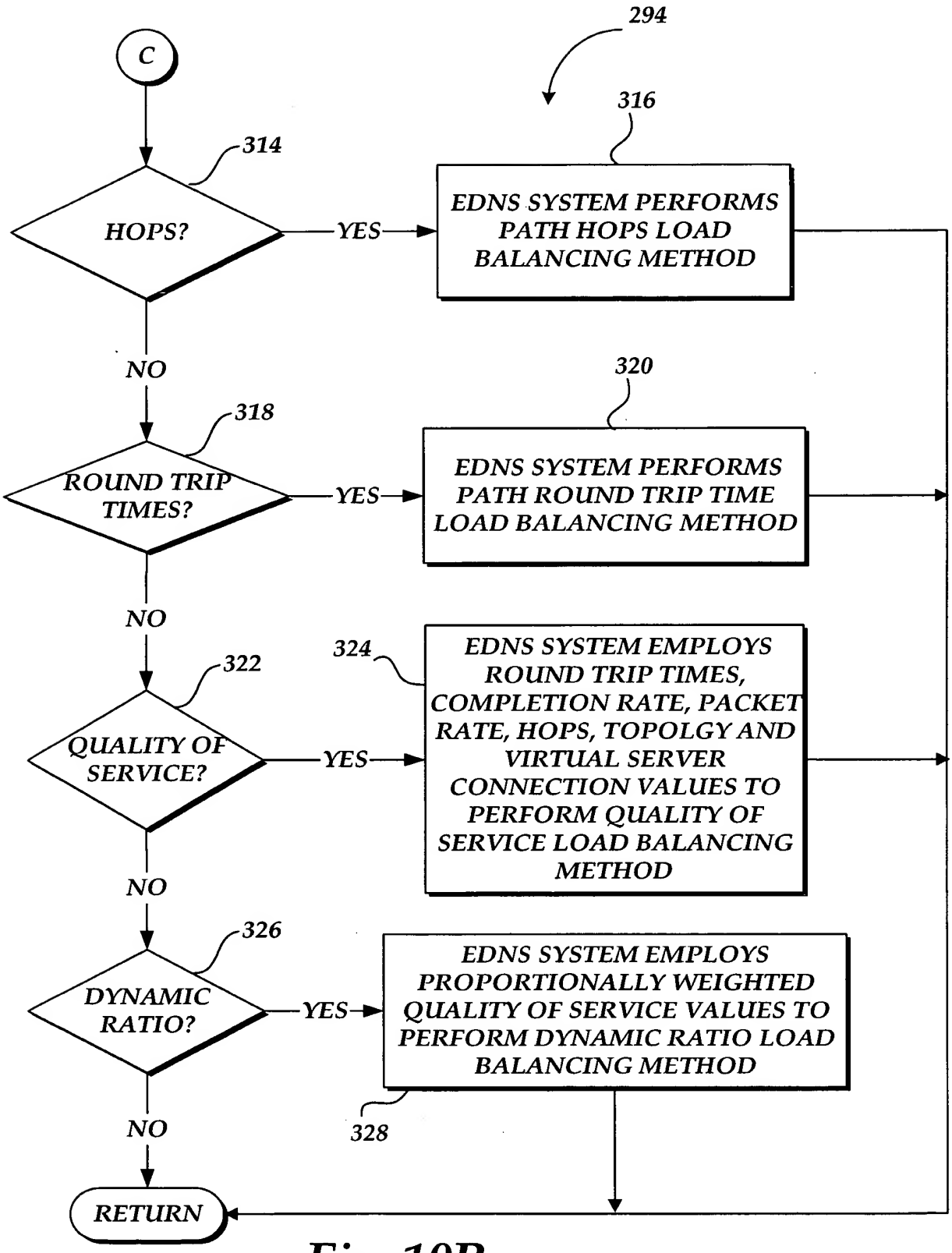

C
294
316
314
HOPS?
YES
EDNS SYSTEM PERFORMS PATH HOPS LOAD BALANCING METHOD
NO
320
318
ROUND TRIP TIMES?
YES
EDNS SYSTEM PERFORMS PATH ROUND TRIP TIME LOAD BALANCING METHOD
NO
324
322
QUALITY OF SERVICE?
YES
EDNS SYSTEM EMPLOYS ROUND TRIP TIMES, COMPLETION RATE, PACKET RATE, HOPS, TOPOLGY AND VIRTUAL SERVER CONNECTION VALUES TO PERFORM QUALITY OF SERVICE LOAD BALANCING METHOD
NO
326
DYNAMIC RATIO?
YES
EDNS SYSTEM EMPLOYS PROPORTIONALLY WEIGHTED QUALITY OF SERVICE VALUES TO PERFORM DYNAMIC RATIO LOAD BALANCING METHOD
328
NO
RETURN

Fig. 10B

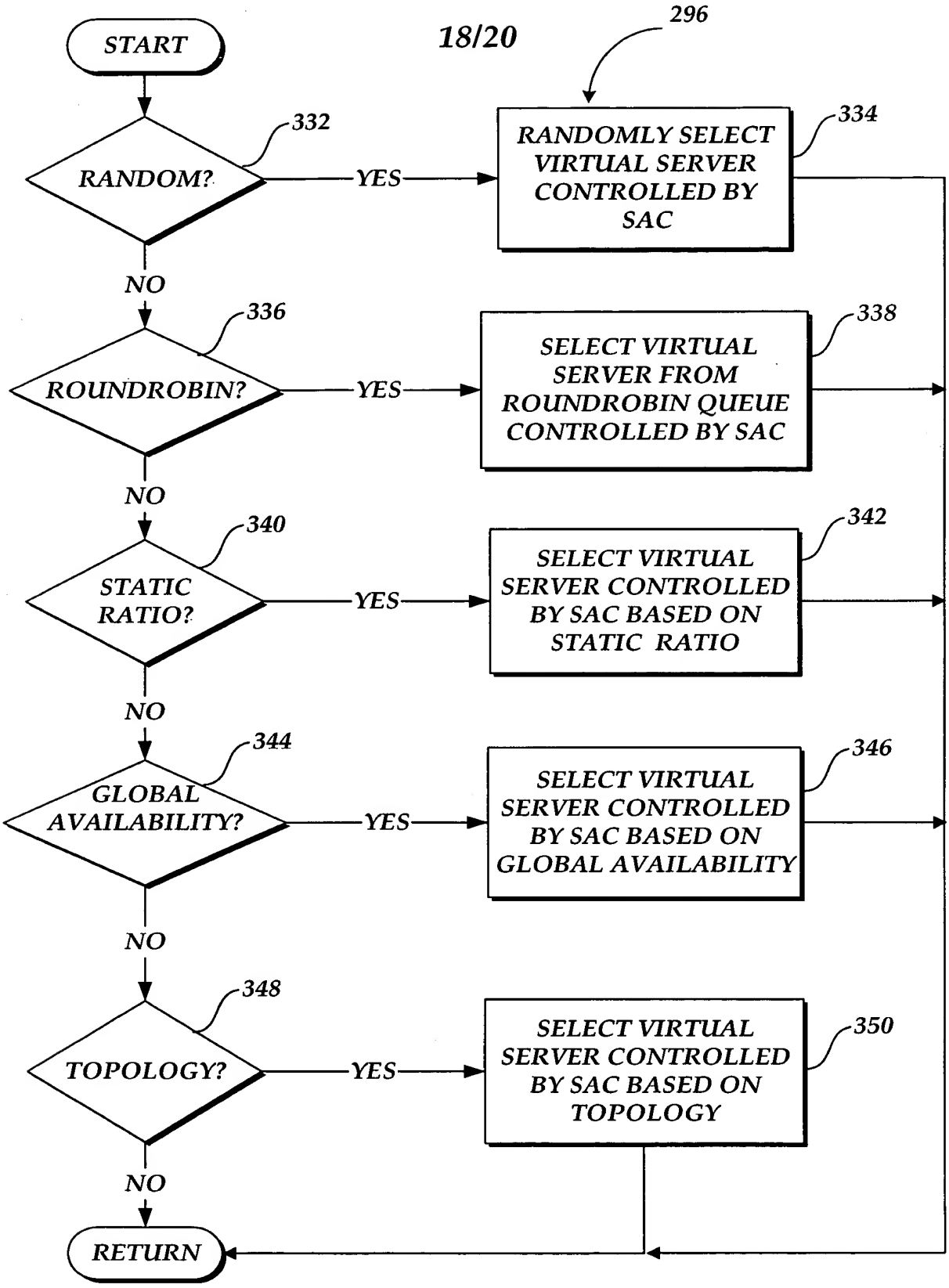
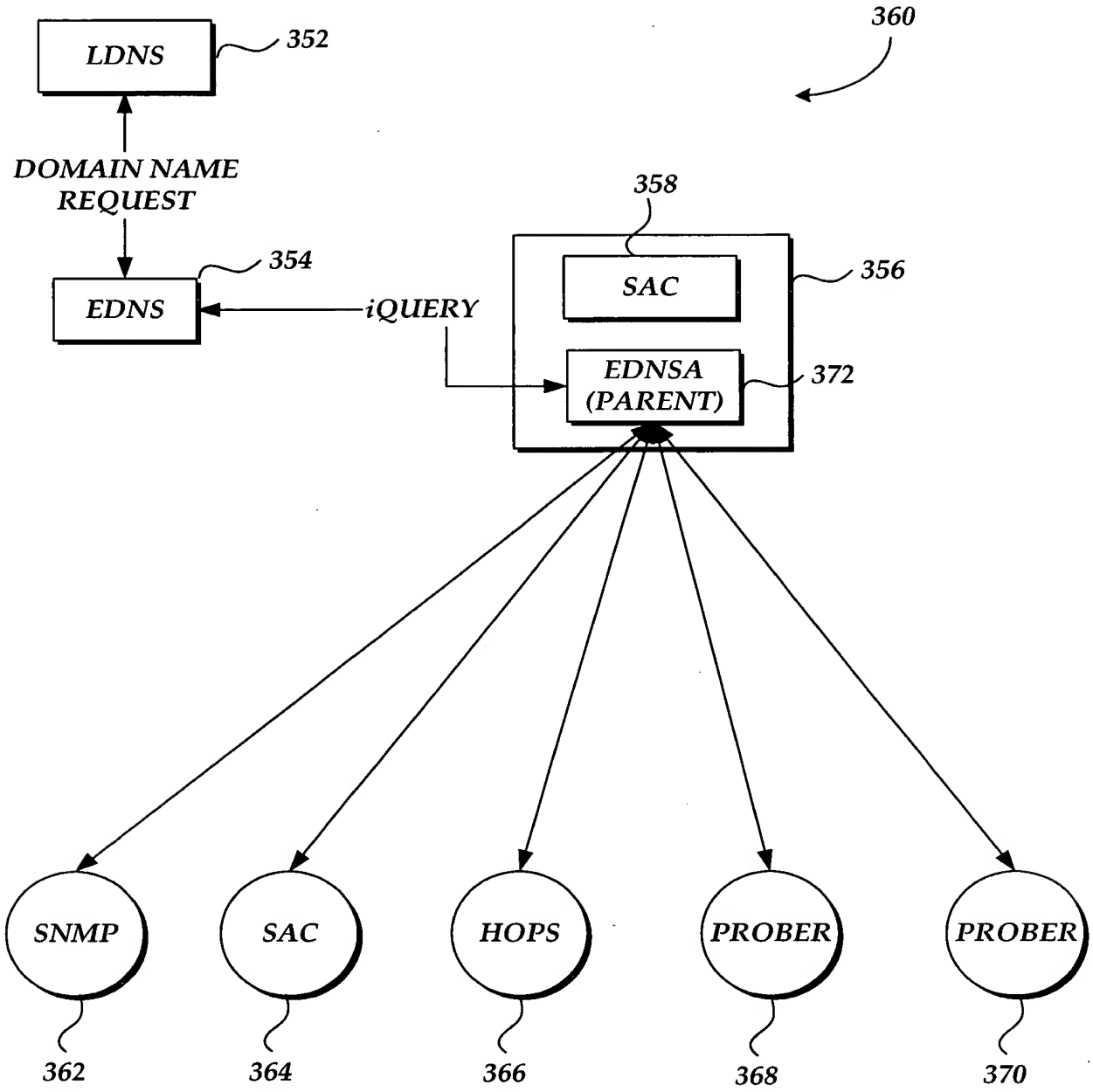

START
RANDOM?
332
YES
296
RANDOMLY SELECT VIRTUAL SERVER CONTROLLED BY SAC
334
NO
ROUNDROBIN?
336
YES
SELECT VIRTUAL SERVER FROM ROUNDROBIN QUEUE CONTROLLED BY SAC
338
NO
STATIC RATIO?
340
YES
SELECT VIRTUAL SERVER CONTROLLED BY SAC BASED ON STATIC RATIO
342
NO
GLOBAL AVAILABILITY?
344
YES
SELECT VIRTUAL SERVER CONTROLLED BY SAC BASED ON GLOBAL AVAILABILITY
346
NO
TOPOLOGY?
348
YES
SELECT VIRTUAL SERVER CONTROLLED BY SAC BASED ON TOPOLOGY
350
NO
RETURN

Fig. 11



CHILD FACTORIES

Fig.12

374

```
TOPOLOGY        {
   ACL_THRESHOLD    1
   LIMIT_PROBES      YES
   LONGEST_MATCH        YES
   // SERVER/MASK (BIG/IP)          LDNS/MASK                SOURCE
   // NORTH AMERICA DOESN'T GO TO THE SOUTH AMERICA DATA CENTER
      200.107.34.0/24               198.0.0.0/8              0
      200.107.34.0/24               199.0.0.0/8              0
   // SOUTH AMERICA DOESN'T GO TO THE NORTH AMERICA DATA CENTER
      199.5.23.0/24                 200.0.0.0/8              0
      199.5.23.0/24                 201.0.0.0/8              0
}
```

Fig.13

376

```
TOPOLOGY SCORE        {
// SERVER/MASK (BIG/IP)        LDNS/MASK              SCORE
/*** NY Office ***/

      /* NY Office --> NJ (high score) */
      209.67.0.0/16             207.25.53.0/24         100

/*** Brazil ***/

      /* Brazil --> Brazil (high score) */
      200.211.0.0/16            200.255.0.0/16         100

      /* Brazil --> Argentina (low score) */
      63.65.0.0/16              200.255.0.0/16         5

      /* Brazil --> New Jersey (low score) */
      209.67.0.0/16             200.255.0.0/16         5

      /* Brazil --> New York (low score) */
      167.216.0.0/16            200.255.0.0/16         5
}
```

Fig.14